

2007 RESEARCH PROBLEM STATEMENT

Problem Title: Water Vapor Flow in Non-Frost-Susceptible Aggregate Base Materials during Freezing **No.:** 07.03-05

Submitted By: Spencer Guthrie

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Project Champion: Rodney Terry

(UDOT or FHWA employee who needs this research done, will help the Research Division lead this project, and will spearhead the implementation of the results. If the project gets prioritized at the UTRAC conference, a Champion Commitment Form will be required before funding.)

1. Briefly describe the problem to be addressed.

The presence of increasing quantities of liquid water in soil or aggregate base materials generally leads to decreasing bearing capacities of the affected layers. While non-frost-susceptible (NFS) materials are routinely specified to varying depths to minimize the occurrence of water ingress by capillary rise, NFS materials generally provide conditions very suitable for water vapor flow because of their comparatively high porosity and low equilibrium degrees of saturation. The occurrence of water vapor flow in response to temperature-induced suction potentials in freezing NFS base/subbase layers may lead to high water contents within the freezing zone and reduced bearing capacities during thawing. In pavements, thaw weakening typically leads to differential settlement, cracking, potholing, and poor ride quality, problems evident in every state that experiences sustained frost action. Investigation of the occurrence of water vapor flow in freezing soil and aggregate layers is needed to explore this potential damage mechanism.

2. Strategic Goal: ☒ Preservation ☐ Operation ☐ Capacity ☐ Safety (check all that apply)

3A. List the research objective(s) to be accomplished:

1. Develop new understanding relative to water vapor flow in freezing soil and aggregate layers.
2. Develop a numerical model for vapor flow in pavement layers.
3. Propose revisions to current design protocols as appropriate.

3B. List the major tasks to accomplish the research objective(s):

Estimated person-hours: 1500

1. Perform comprehensive literature review.
2. Collect material samples and conduct laboratory testing.
3. Collect field data at a selected site.
4. Perform numerical analyses.
5. Write research report.

4. Estimate the cost of this research study including implementation effort (use person-hours from No. 3B): \$40,000

5. Indicate type of research and/or development project this is

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative
☐ Other: _____

(A small project is usually less than \$20,000 and shorter than 6 months)

6. Outline the proposed schedule (when do you need this done, and how will we get there):

A 24-month project duration is proposed. BYU already owns all the laboratory testing equipment necessary for the work.

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7. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

8A. What deliverables would you like to receive at the end of this project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Report, Presentation, Summary of Design Guidelines

8B. Describe how this project will be implemented at UDOT.

The research findings will enable engineers to assess the susceptibility of base/subbase materials to thaw weakening due to water vapor flow and assist them in determining whether or not a soil/aggregate stabilizer may be warranted.

8C. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Implementation of the study findings should reduce the occurrence of premature pavement failures, thereby reducing life-cycle costs and facilitating better pavements for the traveling public.

9. Describe the expected risks and obstacles as well as the strategies to overcome them.

No unusual risks or obstacles are anticipated.

10A. List other people (UDOT and non-UDOT) who are willing to participate in the Technical Advisory Committee (TAC) for this study:

<u>Name</u>	<u>Organization / Division / Region</u>	<u>Phone</u>	<u>Email</u>
Steve Saboundjian	Alaska DOT & PF	907-269-6214	
Howard Anderson	UDOT	801-965-4303	
Brent Hadfield	UDOT	801-965-4835	

10B. Identify other Utah, regional, or national agencies and other groups that may have an interest in supporting this study:

The Alaska DOT & PF will be providing between \$75,000 and \$175,000 to this project. The research team must arrange for an equal match, bringing the total research budget to at least \$150,000. The other team members, who are at the University of Alaska Fairbanks, will obtain the remainder of the required matching funds.